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Role-Playing in a Vaccination Debate Strengthens Student Scientific Debate Skills for Various Audiences †

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INTRODUCTION

Students are surrounded by strongly held viewpoints on scientific topics. We developed the vaccination debate exercise to leverage the student interest in these topics and develop core higher-order cognitive skills (HOCS) (2), including, but not limited to, the ability to critique public media or primary research sources and create arguments in defense of multiple viewpoints. Students prepared to debate different sides of the topic and then randomly assumed one of the roles: "Physician" (pro-vaccination), "Activist" (anti-vaccination), or "Parent-on-the-fence" (undecided). Students reported an increase in their abilities to discuss scientific topics with diverse audiences and an increased awareness of the importance of examining Internet sources for credibility.

PROCEDURE

Study group: undergraduate medical microbiology class

Twenty-two fourth year undergraduate students were enrolled in the course. Nearly all of the students planned to pursue higher education after graduating. Fifteen of the students were female and seven were male. An anonymous post-activity survey measured impact on the study group with a compliance rate of 90%.

Student activity

The vaccination debate exercise fostered the development of HOCS using a dynamic and authentic setting. The instructor expressed no personal opinion, and at no point during either the preparation or evaluation were students asked about their personal opinions.

Students were first lectured on how to examine the credibility of research papers. The paper "Who's afraid of peer review?" was discussed in class (1). The discussion focused on obviously flawed experimental protocols, falsified data, and poorly drawn conclusions in the computer-generated paper. Students also analyzed the data showing that the forged paper was accepted at a surprising number of journals which exposed the negligent nature of peer-review processes used to examine the credibility of manuscripts. In addition, the retracted Wakefield paper linking vaccination and autism was discussed (3). This discussion focused on research bias and the authors' conflicts of interest. To avoid instruction bias, the instructor focused on data provided in the materials and emphasized the difference between data and conclusions.

After the introduction, students were asked to prepare to defend three viewpoints, regardless of personal opinion. The three viewpoints were for vaccination ("Physician"), against vaccination ("Activist"), and undecided and questioning ("Parent-on-the-fence"). A shortlist of Internet resources supporting both sides of the debate was made available to the students (see Appendix 1). Students were also encouraged to find their own sources in the public or academic domain. Students needed to gain knowledge, formulate questions a concerned parent would ask, critically analyze credibility, anticipate questions/points from opposing viewpoints, and create arguments for each perspective.

Prior to the debate, a questionnaire was administered to ensure that students were well prepared (see Appendix 2). Students were given a random number (from 1 to 3) that corresponded to a role and asked to organize into groups of three with one of each number. In each group, students debated the issue and attempted to sway the parent to either perspective. For subsequent rounds of debate, roles were changed and students formed new groups. During each round, the instructor aided groups by asking questions to jog discussion. Between rounds, the instructor reminded the debaters that undecided individuals have different backgrounds and require explanations that are easy to understand and unpretentious. As a cognitive wrap-up, students completed a reflection assignment that asked them to detail the most compelling arguments both for and against vaccination and brainstorm reasons why the anti-vaccination movement continues to date in spite of overwhelming research (see Appendix 3). An anonymous

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survey was also conducted to determine self-perceived student improvement, elicit suggestions, gauge the level of enjoyment, and to evaluate whether the target goals of the activity were met (see Appendices 4–7).

When asked whether the exercise increased their ability to debate a scientific viewpoint, students responded with a mean average score of 6.72 ± 2.76 and a range of 3 to 10 on a Likert scale of 1 to 10, with 10 being greatly increased their ability to debate and 1 being no increase (Appendix 5). In addition, student comments from the anonymous survey were grouped into categories. Eighteen out of the 30 comments made about the most beneficial part of the activity (60%, *n* = 30) stated that assuming different roles was the most beneficial part of the activity (Fig. 1A). More specifically, students were asked to identify important scientific debate skills gained in the activity (Fig. 1B). Thirty percent of comments related to this topic (*n* = 36) said taking into account the audience was important. Other popular categories were making arguments understandable (28%) and citing accurate evidence (25%). All raw data is available in Appendix 8. A few representative comments are included below:

> *Keep biological talk at an appropriate level for the audience. Don't get too technical, explain words, use metaphors.*

> *Think of the best ways to negate their points while increasing your own credibility. Cite different sources accurately.*

Importantly, students exercised their ability to investigate the reliability of a source. Sixty-two percent of total comments (*n* = 24) emphasized the importance of investigating the authors' motives and the research institution that performed the research. Twenty-one percent also mentioned the importance of thoroughly examining experimental protocol, data, and conclusions in research articles (Fig. 1C). Some comments students made when asked what to keep in mind while researching:

> *Are they ACTUALLY reliable, not just fancy looking? Peer-reviewed/being published doesn't make something scientifically sound automatically.*

> *Different sources have different motives for presenting certain data.*

> *It is important to look for conclusions that are not supported thoroughly.*

CONCLUSION

This activity was both enjoyable and beneficial to the students. Students were able to exercise multiple HOCS in the context of a scientific debate with diverse audiences. The vaccination debate harnessed exciting real-world interests and converted them into an academic exercise that promoted the development of crucial critical-thinking skills in a highly participatory activity. For future debates, the authors suggest incorporating a pre-assessment survey or in-class activity to assess what criteria students already use to investigate the reliability of a source, followed by a quiz or homework activity to assess the impact of the debate on those criteria or their application. Example pre- and post-assessment activities have been included in the Appendices (Appendices 9 and 10).

SUPPLEMENTAL MATERIALS

Appendix 1: Provided resources
Appendix 2: Preparation quiz
Appendix 3: Vaccine debate reflection
Appendix 4: Anonymous vaccination debate survey
Appendix 5: Self-perceived responses (*n*=19) on a post-assessment anonymous survey
Appendix 6: Table of student responses when asked if they would like to repeat the activity
Appendix 7: Student suggestions for improvement (total number of comments *n*=22)

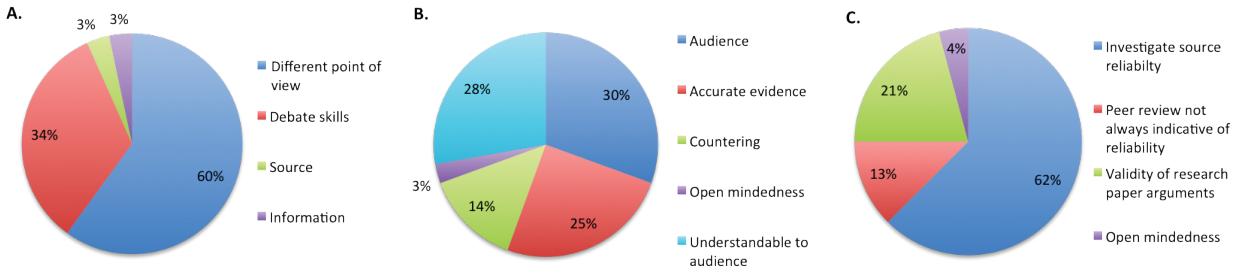

FIGURE 1. Student comment summaries. Student comments were categorized for clarity in summary "pie-chart" figures. Some students had multiple main points in a single comment section and comments were grouped separately. Total number of comments (*n*) is the total number of responses, not the total number of individuals surveyed. (A) Student-perceived most beneficial part of activity (*n* = 30). (B) Student-perceived most important scientific debate skills (*n* = 36). (C) Student-perceived most important considerations while investigating sources (*n* = 24). See supplemental materials for raw comment data (Appendix 8).

Appendix 8: Raw comment data from anonymous survey
Appendix 9: Pre-assessment activity to gauge existing student criterion for investigating the validity of resources
Appendix 10: Post-assessment homework activity to gauge student criterion for investigating the validity of sources

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